MHATT-CAT Stepper Motor Convention for IDC NextStep Drivers

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The purpose of this document is to help people connect stepper motors to the IDC NextStep drivers [1] at MHATT-CAT, the driver most commonly used there. The drivers are bipolar and can supply large current, up to 9.9 A. They also micro-step, normally at 25 μsteps/step (but can go to higher values).

Our stepper motor cables use ELCO connectors, which are the standard at the Advanced Photon Source. The cable on the motor takes the male ELCO connector, with a sample motor cable shown in Fig. 1. The pinout diagram for a male ELCO connector is shown in Fig. 2.

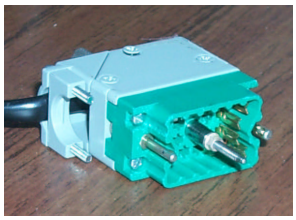

Figure 1: A typical ELCO motor connector at MHATT-CAT.

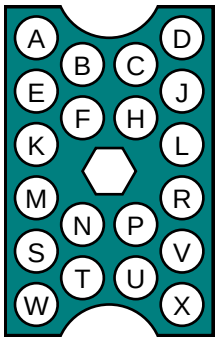

Figure 2: Pinout diagram for the male ELCO connector.

Table 1: MHATT-CAT configuration of motors for bipolar mode

ELCO connector	Signal (phase)	SLO-SYN 4-wire motor	SLO-SYN 6-wire motor	SLO-SYN 8-wire motor (serial mode)	Vexta motor
A	1 out	red	red	red	black
B	1 return	red/white	red/white	red/white	green
C	2 out	white/black	green	green	red
D	2 return	black	green/white	green/white	blue
E *			black	black *and* white †	yellow
J *			white	orange *and* white/black †	white

* not required for MHATT-CAT, but suggested; alternatively, isolate these leads

† **must** connect these wires together

Table 2: MHATT-CAT configuration for limit switches

ELCO connector	Limit switch connection	Huber convention
W	High limit	green
T	*High limit return	white †
X	Low limit	brown
U	*Low limit return	white †

* ground

† the same wire

The wiring diagram for several types of motors is shown in Table 1. Bipolar stepper drivers use four wires to drive a motor, making 4-wire stepper motors simple to hook up. For 6-wire motors, two of the leads are not actually used, being the ones that are common to two coils while used as a unipolar motor; these two wires should be connected as in the table, which not only keeps them electrically isolated, but will also then have it wired as an APS standard unipolar motor (explained below). For 8-wire motors, two pairs of wires need to be connected together so as to put the motor in serial mode, making it functionally the same as a 6-wire motor.

There is support for limit switches on the motors. Most of our motors don't use limit switches, so we keep the limit switch mode as *normally open* so as to not require a jumper on the motor connector. We can switch the setting so that the mode is *normally closed*, with Table 2 describing how to hook up the switches to the connector.

There are other ways of hooking up stepper motors at the APS. The most accepted way is that of SRI-CAT [2, 3] (which is *different* from that of MHATT-CAT). SRI-CAT uses ACS Steppak drivers, which have *unipolar* and micro-stepping *bipolar* types. An SRI-CAT 6-wire motor wired for their *unipolar* driver will work unaltered at MHATT-CAT using our *bipolar* setup. An SRI-CAT *unipolar* 8-wire motor will also work, but one needs to check to see that the pairs E-F and H-J are shorted together on the cable side (some MHATT-CAT cables

Table 3: SRI-CAT bipolar to MHATT-CAT bipolar adapter cable wiring

SRI-CAT motor side	MHATT-CAT driver side
A	A
E	B
C	C
H	D

don't currently have these shorts in place). SRI-CAT stepper motors of any type wired for their *bipolar* drivers will **not** work at MHATT-CAT, but need an adapter cable, with the wiring shown in Table 3; MHATT-CAT has a limited number of these adapter cables already made. Incidentally, BESSRC-CAT wires all their motors according to the SRI-CAT *unipolar* driver convention [4]. Lastly, the SRI-CAT limit switch convention is the same as for MHATT-CAT.

A word of warning is also needed for people using stepper motors at MHATT-CAT. Never unplug a motor unless you are sure the motor is de-energized (with the NextStep driver turned off). Unplugging a live motor can result in a fried connector, as in Figure 3. Note that pins C and D are almost completely destroyed.

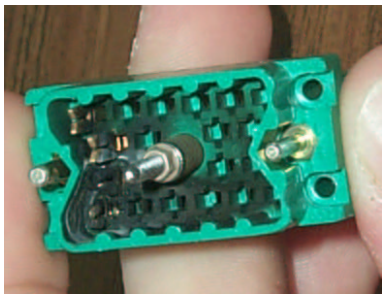

Figure 3: A motor connector that was unplugged when the motor was energized.

References

[1] http://www.idcmotion.com/products/stepmotor/microstepping/nextstep.html

[2] http://www.aps.anl.gov/xfd/bcda/Documents/Motion_Standards/motor_table.html

[3] http://www.aps.anl.gov/~goetze/elco.html

[4] http://www.bessrc.aps.anl.gov/StepperMotor/stepper_motor_connections.html